Climate Change, Blackouts and Society: dress rehearsals for the future

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Abstract
Blackouts serve as a reminder of how dependent mankind has become on electricity and the appliances it powers. Whatever the cause of a blackout, there are patterns in the consequences that take place as a result. These include not only measurable economic losses but also social consequences that are sometimes immeasurable.
This paper reviews almost 50 different significant power-outage events that have occurred in 26 countries, mostly over the last decade. The unpredictable nature of blackouts limits the collection of field data. Hence the data in this paper are collected from reputable media coverage of the events. The patterns that are analysed include economic loss, food, health, crime, social unrest, transport and inequalities

While many blackouts are caused by systems failures, there is a growing trend of failures due to inadequate energy; whether due to depletion of resources such as oil and coal or due to the vagaries of the climate in the supply of renewable energy. As we enter the period of peak oil and climate change the security of energy supply for electricity generation is under threat. Understanding the nature of blackouts is more than just a record of past systems failures; blackouts are dress rehearsals for the future.

1. Introduction

Grid supplies of electricity have democratised energy distribution in countries across the world. The immediate, cheap and reliable supply of electricity has allowed economies to develop at an unprecedented rate in history. The supply of electricity is generally taken for granted and societies have developed an addiction for tools and appliances that are driven by this form of energy. We have become dependent on air-conditioning, computers, lights, fridges and freezers that are, in turn, dependent on an uninterrupted supply of electricity.
Such is our dependency that our comfort, security, communication systems, transport, health, food supply, businesses and social equity systems collapse when electricity supplies are interrupted.

This paper reviews the dependency that societies have on electricity by investigating the failures that occur when electrical systems no longer function adequately. These failures may be because of unpredictable accidents of nature or man-made failures that result in a loss of power that is given many names depending on its cause and consequences; blackouts, rolling blackouts, brown outs, load shedding and power outages.

The information and data in this paper are collected from almost 50 different significant power outage events in 26 countries, mostly over the last decade. The paper pulls together the threads and themes of systems-failure that have occurred. When these events occur, the electrical supply industries are faced with establishing future mitigation systems and much research and risk analysis is carried out following an outage, with the aim of producing a resilient supply in the future. For example, the electricity supply industry produced a book on improving supply security (2) following the power outage in Italy and the USA in 2003.

2. Economic Loss

For several blackout events that have occurred internationally, the direct monetary cost has been calculated. This is generally measured using a simple economic model such as loss of

sales or production. The examples below show that losses vary considerably from minor inconveniences of ATM machine failures to major economic failures costing a country $100s of millions of dollars and even global commodity price increases.
Beijing, China in July 2004 (BBC 2004a); rolling blackouts occurred as energy demand soared. To compensate for this, factories operated only at night in order to save energy on air-conditioning use and the state press urged people to stop wearing suits as a means of keeping cool. Driven by an inadequate supply of resources, state governments introduced rationing of electricity with the logic of turning lights off in one place in order to keep them on in another.

In Chile (BBC 1998d) blackouts in some of the most populated areas, including the capital, Santiago, left offices, shops, and traffic lights without power for a couple of hours at a time over a period of a week in 1998.

In 2008 power cuts in Iran, caused by "endemic bad planning by a corrupt elite" (Guardian 2008b) hastened the demise of the economy. "Without electricity, the economy continues to self-destruct. In the scorching heat, offices cannot operate without air-conditioners and the little manufacturing done in Iran is threatened with even more disasters. Making deals with China necessitated the opening up of the Iranian market to cheap Chinese goods so at this rate the little of it done at home will be destroyed."

In the UK in 2009 (BBC 2009c) a major bank lost its power supply. ATM machines and internet banking ceased with cards being rejected by shops. A reminder of how dependent and vulnerable the banking industry is to an interrupted electricity supply. ATM failure is one of the most common occurrences in all blackouts with significant implications for societies that rely on 'plastic' to be able to purchase.

Easter 2010 in Venezuela (Guardian 2010c) and the president extends the holiday period by 3 days in order to reduce the country's electricity demand. The headlines read: "Hugo Chavez extends Easter holiday to save electricity". Rolling blackouts were imposed on areas of the country and the business community warned the president of a loss of production and food supply shortages. It was also reported that tax return deadlines, due on the 1st April, were unlikely to be met. Turning lights out to keep others on can be more politically expedient than maintaining production.

In Auckland, New Zealand (BBC 1998a), the 5 week long blackout, that hit the central business district and surrounding areas, was estimated to cost NZ$ 120 million to restore the power supply, a further $ 110m to protect the new cable installation and a further $ 70m for compensation claims. A simple failure of cables burning out resulted in the evacuation of the CBD and shut down the economy of the City for weeks.

On Friday, 15th August 2003 parts of Canada and the US were hit by a blackout (BBC 2003b). Trading on the stock exchange was described as "light" as people struggled to get to work and ATM machines stopped functioning. Car manufacturing was hit hard with 12 of General Motors and 24 of Ford's plants closing. Five US and two Canadian airports were closed resulting in about 500 flight cancellations and an estimated "tens of millions of dollars" in losses.

Italy was crippled in 2003 by a tree that fell on a power line (BBC 2003a). The 18 hour blackout exposed the country to almost every aspect of dependency that comes with an addiction. Many of these issues will be raised in the following sections. However, after

only hours of a blackout, it was estimated that the loss of food sales amounted to 50 million Euros and the loss of frozen food, a further 70 million Euros.

25th January 2008, the largest gold mines and two biggest Platinum mines (supplying half of the world's Platinum) in South Africa were forced to shut down due to 'load shedding' (BBC 2008b). Within minutes, the world price of these commodities rose by 5%.

3. Food and Health

The loss of the ability to keep food fresh has many consequences. An economic loss by is the most commonly reported issues. For example, in the heat of Zanzibar (BBC 2008c) small traders realised that the food would go bad in dysfunctional freezers after a blackout that lasted several days. In the case of Abuy, a shopkeeper, the most popular products were frozen chicken and ice cream. Having given away his ice cream at the early stages of the blackout, he later found the chickens were going bad. Nobody was buying them because they had no alternative means of cooking other than the electric stoves they had become dependent on.

In 2010 in Hebei Province China (Guardian 2010a), the authorities imposed electricity rationing to meet there energy efficiency targets. Tens of thousands of households were left without electricity for 22 hours out of 3 days with the consequent loss of refrigeration. Milk curdled and vegetables rotted as a penalty for industries that exceeded targets of energy consumption as China tried to prove to the world that it was contributing to the reduction of greenhouse gases.

In Kenya (EE Publishing 2010) blackouts in 2010 were so frequent that, "restaurants have gotten so used to blackouts that they design their menus around them". As a blackout fell, staff scrambled to get generators running to avoid food going bad, but cooks could not cook food fast enough because of the lack of stoves.

The tragic consequence of a lack of refrigeration was felt in Pakistan in 2010 (Guardian 2010b). Load-shedding during the heat wave resulted in 12hours a day without electricity, hundreds died of food poisoning as the poor ate bad food from their freezers.

4. Crime and social unrest

When the lights go out, crime increases. Without electricity security, systems fail and blackouts offer an opportunity for fraud, theft and exploitation. Persevering extended periods without electricity or intermittent periods of rolling blackouts caused by load shedding, is hard to endure and leads to unrest.
In Zanzibar (BBC 2008c), following four weeks of an electricity blackout in 2008, it was announced that power had at last been restored. But not for many, as the opportunity of making money out of the scrap metal value of electricity cables was too tempting while the cables were not 'live'.

Auckland, New Zealand (BBC 1998b), suffered a blackout for five weeks. The police adopted 'saturation policing', doubling patrols and using private security guards, to prevent looting. However, it was the only place in the sample where crime was reported to have reduced. As the city centre closed down after weeks of a blackout, the visitors left and the empty streets offered little opportunity for the petty criminals. The BBC headlines read "Kiwi blackout drives criminals off the streets" (BBC 1998c).

There was a more sinister side of blackouts that occurred in Brazil in 2009 (BBC 2009d). With the lights out, the gangs also take to the streets. One of the first actions in the

blackouts of 2009 in San Paolo and Rio was an immediate increase of the police on the streets. As one commentator stated (BBC 2009e) “An already dangerous city has just become infinitely more dangerous.”

In South Africa in 2008 (Guardian 2008a), an increase in robbery occurred during times of blackouts including premeditated and violent robbery from cars returning home and being delayed in the street while the electric gates had to be opened manually. In the meantime, commuters in Pretoria set fire to six trains after services were delayed for two hours by the loss of power.

In Pakistan (Guardian 2010b) people were forced to clandestinely tap into the electrical grids of rich communities because the retail price was too prohibitive. In 2009 this was estimated to cost 138m GBP in lost revenues. However, blackouts temporarily eliminate electricity theft that is common in many Asian cities.

In 2006 in Tanzania (BBC 2006) the rains failed and the hydro dams ran almost dry. The Energy Minister realised the importance of electricity, "It is important to have light at night to curb crime". Rolling blackouts were enforced over a 6 week period from 8am to 5pm each day. In the meantime, religious leaders asked people to pray for rain to replenish the hydro dams.

In Pakistan (Guardian 2010b) it was estimated that 53% of the population went without power for 8 hours of the day in 2009. The power cuts tend to occur during the hot summers. The high temperatures and hikes in energy prices were a recipe for unrest. “In Karachi and throughout the Punjab last week angry mobs went on a rampage and assailed power companies in frustration at the long daily power cuts that have brought modern life to a standstill”.

5. The problem of Generators

Generators, commonly diesel fuelled, are a lifeline to householders, hospitals and businesses. However, the noise and pollution caused by this equipment is a common theme in blackout events. Generators have also become symbols of a divisive tool that emphasises the rift between rich and poor as the cost of the generators and the fuel to run them are prohibitive to all but the rich.

After years of war and corruption, Nepal’s electricity supply was rationed with about 16 hours a day of blackout (BBC 2009a). With this level of electricity interruption schools, businesses and households cease to function in a world that relies on the internet. To be able to maintain some level normality, those who could afford it, purchased a generator. Under these circumstances, Nepal has become a dark country;”one where the rich are buying generators and the poor are having to re-plan the patterns of their lives”.

In 2010, a combination of war, corruption and incompetency left Baghdad (BBC 2010a) with electricity for only about 2 hours per day. When the grid supply of electricity returns for even a short period; “instead of the din of a thousand diesel engines, the sounds of traffic and birdsong drift gently on the evening air. It is a blissful feeling.” So common are blackouts that a new form of enterprise has started: the communal generator which can power a few dozen houses of businesses for a monthly fee.

Blackouts in Tanzania (BBC 2006) and Zanzibar (BBC 2008d) had a similar impact with the noise of generators being heard throughout the cities. Small businesses purchase generators but the cost of fuel results in unsustainable trading; “The cost of running a generator for one day is the equivalent to half a month's electricity bill”. Generators were

also provided by the government near wells in order to pump water, though the need for charging mobile phones was also considered “desperate”.

In the Gansu province of China in the second half of 2010 (Guardian 2011), local government enforced rolling blackouts and factory shutdowns in order to reach its energy efficiency targets. As a consequence, the use of diesel generators surged so that factories and homes could produce their own electricity. There was competition for diesel fuel between its traditional use for transport and the new use of private electricity generation, causing cues for diesel at filling stations.

A further problem, faced in the Italian blackout of 2003 (BBC 2003a), was an inadequate supply of diesel. Hospitals in the country switched over to their back-up diesel generators only to find their substantial power demands exhausted their supplies of fuel. A similar situation occurred in Iran (Guardian 2008b) in 2008 and resulted in reports of deaths in Tehran's hospitals.

Pakistan, 2010, (Guardian 2010b) with 12 hours a day without electricity and record breaking temperatures (53^{o}C), tolerating life without fans, fridges or air-conditioning was more than just inconvenience. For those rich enough, a generator is an essential piece of equipment. However they are divisive, “The wealthy will switch on their generators to keep a running supply of power every time the electricity trips; the poor are simply left to swelter and suffer.”

6. Conclusions

Power outages will always occur because of the vagaries of climate and the vulnerability of human systems. However, the growing trend in the cause of blackouts is the depletion of fossil fuel resources for power generation and the transient nature of renewable energy sources.

The ability to provide an uninterrupted supply of electricity in both developed and developing countries can no longer be taken for granted and the situation is likely to get worse as countries consume ever more electricity for air-conditioning, electric vehicles and other electrical appliances.

In countries where the electricity grid has a wide and affordable coverage, the supply has brought about an equitable distribution of energy for the majority. However, it has also brought with it a dependence that carries a high cost when it is removed. Such is our dependency that our comfort, security, communication systems, transport, health, food supply, businesses and social equity systems collapse when electricity supplies are interrupted.

The cost of blackouts goes beyond the immediate monetary losses and reaches those externalities at the heart of our basic needs. The cheap and readily available sources of energy that have fuelled the engines of economic growth are reaching peak production. While plentiful, these resources have created a dependence on an uninterrupted supply of electricity. In scarcity, they expose the inequities and vulnerabilities of society.

References

All web references accessed on 25th April 2011

Aljazeera (2009) Power cut hits millions in Brazil http://english.aljazeera.net/news/americas/2009/11/200911113272714187O.html

BBC (1998a) Auckland faces at least six weeks without power. http://news.bbc.co.uk/2/hi/asia-pacific/61828.stm

BBC (1998b) Normal power supplies still over a week away. http://news.bbc.co.uk/2/hi/asia-pacific/59641.stm
BBC (1998c) Kiwi Blackout drives criminals off the streets. http://news.bbc.co.uk/2/hi/asia-pacific/62952.stm
BBC (1998d) Americas electricity cuts hit Chile. http://news.bbc.co.uk/2/hi/americas/217122.stm
BBC (2001a) California declares state of emergency http://news.bbc.co.uk/2/hi/business/1121453.stm
BBC (2001b) Power blackout hits Iran. http://news.bbc.co.uk/2/hi/middle_east/1341027.stm
BBC (2002) Indian state curbs electricity to industry. http://news.bbc.co.uk/2/hi/business/2016611.stm
BBC (2003a) Huge blackout cripples Italy. http://news.bbc.co.uk/2/hi/3146136.stm
BBC (2003b) Firms struggle to resume business http://news.bbc.co.uk/2/hi/business/3152871.stm
BBC (2004a) Beijing 'brown-out' to save power. http://news.bbc.co.uk/2/hi/asia-pacific/3916789.stm
BBC (2004b) China's energy supply dwindling. http://news.bbc.co.uk/2/hi/business/3732369.stm
BBC (2006) Tanzania cuts power after drought. http://news.bbc.co.uk/2/hi/africa/4673130.stm
BBC (2008a) Power crisis hits Indian states. http://news.bbc.co.uk/2/low/south_asia/7524925.stm
BBC (2008b) Mines shut as South Africa faces electricity 'emergency' http://www.guardian.co.uk/world/2008/jan/25/southafrica.business
BBC (2008c) Zanzibar celebrates power return. http://news.bbc.co.uk/2/hi/africa/7461995.stm
BBC (2008d) Week-long blackout hurts Zanzibar. http://news.bbc.co.uk/2/hi/africa/7423444.stm
BBC (2009a) Nepal becomes land of the blackout. http://news.bbc.co.uk/2/hi/south_asia/7854167.stm
BBC (2009b) UK 'could face blackouts by 2016'. http://news.bbc.co.uk/2/hi/science/nature/8249540.stm
EE Publishing (2010) Droughts turn out
BBC (2009c) Power failure hits HBOS customers. http://news.bbc.co.uk/2/hi/uk_news/8360313.stm
BBC (2009d) Major power failure hits Brazil. http://news.bbc.co.uk/2/hi/americas/8353878.stm
BBC (2009e) Brazil blackouts: readers accounts. http://news.bbc.co.uk/2/hi/americas/8354630.stm
BBC (2010a) Baghdad diary: Searching for power http://news.bbc.co.uk/2/hi/world/middle_east/10437279.stm
BBC (2010b) Power cuts loom for Venezuelans as dam runs dry. http://news.bbc.co.uk/2/hi/americas/8455592.stm
EE Publishing (2010) Droughts turn out the lights in hydro-dependent region. http://www.eenews.net/public/Greenwire/2010/05/10/1
BBC (2011) Ivory Coast: Power and water cut to pro-Ouattara north http://www.bbc.co.uk/news/world-africa-12629109
Guardian.co.uk (2006) Australians fight fear of power crisis with giant solar sitehttp://www.guardian.co.uk/environment/2006/oct/26/energy.australia
Guardian.co.uk (2008a) Power cuts a good sign, sceptical South Africans told http://www.guardian.co.uk/world/2008/jan/21/southafrica.chrismcgreal
Guardian.co.uk (2008b) Iran's lights are going out, http://www.guardian.co.uk/commentisfree/2008/sep/02/iran.energy
Guardian.co.uk (2008c) Mines shut as South Africa faces electricity 'emergency' http://www.guardian.co.uk/world/2008/jan/25/southafrica.business
Guardian.co.uk (2010a) China resorts to blackouts in pursuit of energy efficiency http://www.guardian.co.uk/world/2010/sep/19/china-blackouts-energy-efficiency
Guardian.co.uk (2010b) Pakistan's heat wave and deadly lack of energy policy. http://www.guardian.co.uk/commentisfree/2010/jun/07/pakistan-energy-policy-proving-deadly
Guardian.co.uk (2010c) Hugo Chavez extends Easter holiday to save electricity. http://www.guardian.co.uk/world/2010/mar/25/hugo-chavez-venezuela-easter-holidays
Guardian.co.uk (2011) China resorts to blackouts to meet energy saving targets. http://www.guardian.co.uk/environment/gallery/2011/feb/03/china-year-in-environment#/?pictur e=371370996&index=14
International Energy Agency (2005) Learning from the Blackouts. OECD/IEA Publications
Saturday Nation (2011) Power outage plunges Kenya into darkness. http://www.nation.co.ke/News/-/1056/680492/-/uokf5x/-/index.html
Sky.com (2009) Brazil power cut leaves millions in darkness. http://news.sky.com/skynews/Home/World-News/Brazil-Power-Cut-Millions-Without-Power-In-Sao-Paulo-And-Rio-De-Janeiro-After-Electrical-Outage/Article/200911215451224?lpos=World_News_First_Home_Article_Teaser_Region_1&lid=ARTICLE_15451224_Brazil_Power_Cut%3A_Millions_Without_Power_In_Sao_Paulo_And_Rio_De_Janeiro_After_Electrical_Outage